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(54) IMPROVEMENTS IN OR RELATING TO SURGE VOLTAGE PROTECTION DEVICES

(72) We, SIEMENS AKTIENGESELLSCHAFT, a German Company of Berlin and Munich, German Federal Republic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to surge voltage protection devices.

Two-terminal devices are already known, for example, from German Patent Specification No. 1,192,733 in which surge voltage arresters having spark gaps have voltage-dependent resistors connected in series with the spark gaps, and voltage-dependent control resistors connected in parallel with the spark gaps between the two terminals. In surge voltage arresters it is desirable to keep the sparkover voltage as low as possible consonant with ensuring that extinguishing takes place. A uniform voltage distribution between the spark gaps of a high voltage arrester is generally produced by means of ohmic or voltage-dependent resistors which are connected either in parallel to each spark gap or in parallel to groups of spark gaps, in addition to voltage-dependent resistors connected in series with the spark gap or group of spark gaps.

To control the voltage distribution, the use of the combination of a control resistor, which may be voltage-dependent, and a control capacitor, both connected in parallel with the spark gap, has also been suggested, for example, in U.K. Patent Specifications Nos. 1,126,512 and 1,224,956.

Voltage-dependent resistors are disclosed, for example, in German Patent Specification No. 1,765,097. Non-linear resistors of this type may consist, for example, of a sintered plate of zinc oxide which is provided on its opposite faces with respective electrodes, one of the electrodes having an ohmic contact with the plate and the other of the electrodes having a rectifying contact therewith. Examples of other non-linear resistors include silicon carbide varistors, selenium rectifiers, and germanium or silicon p-n surface-contact rectifiers.

Gas-filled surge voltage arresters are also already generally known (for example, from German Patent Specification No. 1,089,482). Surge voltage arresters of this kind basically consist of two spaced electrodes which are fused in gas-tight fashion to an interposed insulating body to form a gas-tight discharge chamber. As the atmosphere in this discharge chamber, it is advantageous to use an inert gas which does not react with the electrodes producing the discharge. The sparkover voltage of the surge voltage arrester is derived from Paschen's law for a given gas pressure and electrode spacing. Under surge voltage conditions, with an increasing voltage gradient over a period of time, an increase in the sparkover voltage is also observed. Accordingly, when there is a linear increase in the voltage gradient there is a corresponding delay in sparkover which is proportional to the increased sparkover voltage. Since the gas path between the electrodes predominantly effectively forms an insulator, in the event of a steep rise in the surge voltage with respect to time, free electrons must first produce ionisation by impact, charge carriers which transport the current. The delay in sparkover or ignition is therefore very considerably influenced by the presence of free electrons. When there are sufficient free electrons present, it is possible to reduce the ignition delay by a very considerable amount. If radioactive materials which liberate primary or secondary electrons, are introduced into the discharge chamber, the delay in ignition, and thus the impulse sparkover voltage, are reduced. Radiators which can advantageously be used include tritium and promethium 147. With steep voltage gradients, it is also possible to reduce the impulse sparkover voltage by the use of so-

called ignition strips, i.e. strips of electrically conductive material xtending between the electrodes to leave one or more ignition gaps. The micro-discharges of the ignition strip produce free electrons by field-electron emission with a small ignition delay. The effect on the ignition strip on the reduction of the impulse sparkover voltage is, however, very dependent upon the quality of the strip. It is only possible to achieve uniform qualities of the ignition in mass production, however, at a substantial cost. The known surge voltage arresters have hitherto been produced with insulating bodies of glass or ceramic which require the use of different materials for the ignition strips because of the different bonding strengths involved. In order to ensure reproducibility in sparkover d.c. voltage, a surge voltage arrester which is provided with an ignition strip must additionally be provided with a weak radioactive doping.

It is an object of the present invention to provide a surge voltage protection arrangement having a reduced impulse sparkover voltage and a very short ignition delay time.

According to the invention, there is provided a two terminal surge voltage protection device consisting of a gas-filled surge voltage arrester and a voltage-dependent resistor forming respective arms that are connected in parallel between said two terminals, wherein said gas-filled surge voltage arrester is a knob arrester, in which two frusto-conical electrodes are inserted into respective ends of a tabular insulating body so that their flat end portions face each other, and so that they seal their respective ends and wherein the voltage-dependent resistor is a metal oxide varistor. These two components, connected in parallel, can be housed in a common housing in a particularly space-saving fashion.

After the ignition delay time, the discharge current transfers from the metal oxide varistor to the gas discharge arrester since the internal resistance of the latter is considerably lower than that of the metal oxide varistor. Consequently, the metal oxide varistor need only be designed in terms of power for a short operating time corresponding to the ignition delay time of the gas discharge surge voltage arrester. This completely rules out any possiblity of overloading the metal oxide varistor.

The invention will now be further described with reference to the drawing with is a circuit diagram of one exemplary device constructed in accordance with the invention.

In the illustrated device a gas-filled surge voltage arrester 1 is connected in parallel with a voltage-dependent resistor 2 between two terminals. The surge voltage protection device so produced is connected across the potential with is to be protected. The gas-filled surge voltage arrester 1 is a so-called "knob arrester" in which two electrodes in the form of frusto-cones, are inserted with their end portions opposite to one another in gas-tight fashion into the ends of the tubular insulating body consisting of glass or ceramic; such knob arresters are particularly noteworthy for their small dimensions. A metal oxide varistor is used as the voltage-dependent resistor 2. The voltage-dependent ceramic of such a varistor may, for example, have a basis of zinc oxide, titanium oxide, copper oxide, or iron oxide.

WHAT WE CLAIM IS:—

1. A two terminal surge voltage protection device consists of a gas-filled surge voltage arrester and a voltage-dependent resistor forming respective arms that are connected in parallel between two terminals, wherein said gas-filled surge voltage arrester is a knob arrester in which two frusto-conical electrodes are inserted into respective ends of a tabular insulating body so that their flat end portions face each other, and so that they seal their respective ends and wherein said voltage-dependent resistor is a metal oxide varistor.

2. A surge voltage protection device as claimed in Claim 1, substantially as hereinbefore described with reference to and as shown in the drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*